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Prognostic Value of Myocardial Viability and Ischemia Detected by Dobutamine Stress Echocardiography Early After Acute Myocardial Infarction Treated With Thrombolysis

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Objectives. **The aim of the study was to assess the prognostic value of myocardial viability and ischemia detected by dobutamine stress echocardiography (DSE) in patients with acute myocardial infarction (AMI) treated with thrombolysis.**

Background. **DSE can detect myocardial viability and ischemia early after AMI, but the prognostic importance of viability and ischemia in these patients has yet to be assessed.**

Methods. **DSE was performed in 152 patients at a mean of 9 ± 5 days after a first AMI treated with thrombolysis to evaluate myocardial viability and ischemia. The patients were followed up for 15 ± 19 months.**

Results. **On the basis of DSE results three groups of patients were identified: group 1 (95 patients, 62.5%) with myocardial viability and ischemia, group 2 with myocardial viability without ischemia (32 patients, 21%) and group 3 (25 patients, 16.5%) with no myocardial viability. During follow-up 10 patients (6.5%) had hard events, 53 (35%) developed unstable angina and 67 (44%) underwent myocardial revascularization. The rate of hard events was 10% in group 1 and 0% in group 2 and 3 patients ($p < 0.05$ group 1 versus group 2); group 1 patients with viability and ischemia showed a significantly higher rate of recurrence of unstable angina and myocardial revascularization procedures (40% and 60%) compared to group 2 (22% and 16%) and group 3 patients (20% and 20%). Using the Cox multivariate stepwise model, only the extent of ischemic myocardium (hazard ratio (HR) = 21.7, $p = 0.02$) and angina during DSE (HR = 4.45, $p = 0.03$) were significant predictors of hard events; an ischemic response to DSE (HR = 2.92, $p = 0.001$) was the most important predictor of spontaneous events, followed by ST-segment depression during DSE (HR = 1.71, $p = 0.04$), angina during DSE (HR = 1.53, $p = 0.19$) and age (HR = 0.96, $p = 0.05$).**

Conclusions. **In patients with a first AMI treated with thrombolysis the presence and extent of myocardial ischemia during DSE is the most important predictor of both hard and spontaneous cardiac events, whereas myocardial viability does not have an independent prognostic value.**

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In survivors of acute myocardial infarction (AMI) early assessment of prognosis is of major importance for identifying patients at high risk of subsequents events and guiding therapeutic decisions. Several studies in the prethrombolytic era showed that impaired left ventricular (LV) function, multivessel coronary disease and the presence of inducible ischemia are the most important predictors of an adverse outcome after AMI (1–4). Thrombolytic treatment has improved the prognosis of patients with AMI through its potential to salvage viable myocardium at risk in the infarct zone, reduce infarct size and improve LV function (5–8); however, viable but jeopardized myocardium supplied by a critical residual coronary stenosis can be at increased risk of further ischemic events and adversely affect prognosis.

Dobutamine stress echocardiography (DSE) offers the unique opportunity of evaluating both myocardial viability and ischemia early after AMI (9–12); however, recent studies in patients with AMI or postinfarction LV dysfunction (11,13–15) have led to conflicting results on the prognostic significance of myocardial viability and ischemia detected by DSE. Thus, the purpose of this study was to assess the prevalence and clinical correlates of myocardial viability and ischemia detected by DSE and to evaluate prospectively their prognostic importance in patients with a first AMI treated with thrombolysis.

Methods

Study population. The initial study population was composed of 181 consecutive patients admitted to our Coronary Care Unit who fulfilled the following prospectively defined selection criteria: 1) first episode of AMI diagnosed on the basis of chest pain of >30 min, evolutionary ST-segment and T-wave changes and an increase in creatine kinase and MB fraction serum levels to at least twice the upper limits of normal values; 2) intravenous thrombolysis within 6 h from

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Abbreviations and Acronyms

AMI = acute myocardial infarction
CI = confidence intervals
DSE = dobutamine stress echocardiography
HR = hazard ratio
LV = left ventricular
WMSI = wall motion score index

onset of chest pain; 3) age ≤70 years; and 4) no life-limiting systemic disease. Of the 181 patients initially eligible for the study, 5 (2.8%) died and 16 (8.8%) developed early complications and therefore, were excluded from the study; 8 patients (4.4%) had a poor echocardiographic window in baseline conditions, and were also excluded. The final study population consisted of 152 patients with a first AMI treated with thrombolysis who had no major in-hospital complications and a satisfactory baseline echocardiographic examination.

Dobutamine stress echocardiography. The test was performed at a mean of 9 ± 5 days (range 6 to 15 days) after AMI. The study protocol was approved by the local institutional committee on human research and all patients gave written informed consent. Dobutamine was administered according to a previously described protocol (13,15), including atropine administration if the test was negative at the 40 μg/kg/min dose and heart rate did not reach 85% of maximal age-predicted heart rate. End points of the test have been described in detail elsewhere (10,13). Using a commercially available ultrasound imaging equipment (Sonos 1000, Hewlett-Packard) two-dimensional images in parasternal long- and short-axis and apical four- and two-chamber views were obtained at baseline, at each step of DSE and during recovery and recorded on a super-VHS videotape for subsequent analysis. In addition to videotape recording, in the last 90 patients selected cardiac cycles at baseline, 10 μg/kg/min dobutamine dosage, peak stress and recovery were digitized on-line and compared off-line in a cine-loop mode using a quad-screen display.

Echocardiographic analysis. All examinations were reviewed by two independent observers blinded to the clinical data of the patients. For LV wall motion analysis standard 16-segment model of the left ventricle of the American Society of Echocardiography was used (16) and wall motion was scored as 1 = normal; 2 = hypokinetic; 3 = akinetic; 4 = dyskinetic. A LV wall motion score index (WMSI) was calculated at baseline, low (10 μg/kg/min) and peak dobutamine dosage. LV segments were grouped according to AMI and non-AMI zone location; the site of AMI was defined as anterior, inferior or lateral on the basis of the electrocardiographic changes in the acute phase. Infarct zone was evaluated according to the theoretical maximal risk area (17), which included nine segments for anterior AMI, six for inferior AMI and five for lateral AMI. Apical inferior, apical lateral and basal and midposterior segments were considered overlap segments.

A segment was defined as viable when during low-dose DSE systolic wall thickening and endocardial motion appeared in a basally akinetic or dyskinetic segment or normal or near-normal wall motion and thickening became apparent in a severely hypokinetic segment. Myocardial viability was considered to be present in the infarct zone when the improvement involved at least two segments or at least one segment when only two were basally asynergic. The diagnosis of DSE-induced myocardial ischemia in the infarct zone was made when 1) a basally akinetic or hypokinetic segment, after improving its thickening and motion at low doses, showed a significant deterioration at peak stress (biphasic response); 2) a basally hypokinetic segment showed a direct deterioration to akinesia or dyskinesia; and 3) a new asynergy developed in a basally normal segment. Akinesia directly deteriorating to dyskinesia was not thought to be indicative of ischemia. Ischemia at a distance was diagnosed when a new or worsening asynergy developed in segments not included in and not contiguous to the infarct zone. To provide a semiquantitative estimate of the extent of viable and ischemic myocardium, the difference between basal and low-dose DSE WMSI, which estimates the extent of viable myocardium, and the difference between peak stress and low-dose DSE WMSI, which estimates the extent of ischemic myocardium, were calculated.

Follow-Up. Follow-up data were obtained through review of the patient's hospital record, periodic visits by a staff physician in the outpatient clinic and telephone interview with the patient by trained personnel. None of the patients was lost to follow-up. The clinical events recorded were cardiac death, nonfatal myocardial infarction and unstable angina, defined according to previously published criteria (13). Because the decision to perform revascularization procedures may not reflect a clinical event, these procedures were considered separately from spontaneous events; however, as revascularization can affect patient outcome, follow-up was censored after the procedure. Therefore, the outcome events were analyzed as hard events (defined as cardiac death and nonfatal AMI), spontaneous events (death, nonfatal AMI and unstable angina) and total cardiac events (spontaneous events and revascularization procedures). Only the initial event was considered for each patient and the follow-up was stopped at the time of this event. The observation period was censored at last assessment in event-free patients.

Statistical analysis. Results are given as mean value ± standard deviation. Cumulative curves of survival were calculated by means of the product-limit method of Kaplan and Meier. The individual effect of demographic, clinical and echocardiographic variables on survival was evaluated with the use of the Cox regression model (StataCorp. 1997, Stata Statistical Software, release 5.0). All variables analyzed in the study were first evaluated by univariate analysis using either log rank test for categorical variables or Cox regression for continuous variables. Those variables that showed an association with the outcome at a p level <0.1 were included in the multivariate Cox model, selected according to a backward stepwise selection process and entered into or removed from the regression equation on the basis of a computed significance probability value. A p value <0.05 was considered statistically

significant. Hazard ratio (HR) together with 95% confidence intervals (CI) are given for the Cox models.

Differences in clinical variables between the three groups of patients were evaluated by analysis of variance followed by Scheffé test for continuous variables and by Pearson chi-square test for categorical variables. Differences between paired data were analyzed by Student's paired *t* test; nonparametric differences were examined using a chi-square test. A p value of <0.05 was considered significant.

Results

Study population. The study group consisted of 142 men and 10 women, with a mean age of 54 ± 8 years. The electrocardiographic site of AMI was anterior in 78 patients (51%) and inferior or inferolateral in 74 patients (49%); 112 patients (74%) had a Q-wave and 40 (26%) a non-Q wave AMI. Mean peak creatine kinase was 2,140 ± 1,614 IU/L and was reached at a mean of 15 ± 3 h after admission. Streptokinase (1,500,000 U over 1 h) was administered to 45 patients, alteplase (recombinant tissue-type plasminogen activator, 15 mg bolus followed by 50 mg over 1 h and 35 mg over 2 h) to 99 patients and saruplase (single-chain urokinase plasminogen activator, 20 mg bolus followed by 60 mg over 1 h) to 8 patients.

Feasibility, safety and hemodynamic findings. The echocardiographic images during DSE were considered interpretable in all patients. No major complication occurred during DSE. Limiting side effects leading to the interruption of DSE occurred in 7 patients (5%) and included increase in systolic blood pressure to >230 mm Hg in five patients, symptomatic sustained ventricular tachycardia in one patient and symptomatic hypotension in one patient. Compared to baseline values heart rate, systolic blood pressure and double product increased significantly at peak stress in all three groups. Fifteen patients in group 1 (16%), 18 in group 2 (56%) and 11 in group 3 (44%) reached 85% of maximal age-predicted heart rate.

Dobutamine stress echocardiography. Interobserver concordance was 98% (150 of 152 patients) for assessment of baseline wall motion abnormalities, 94% (143 of 152 patients) for evaluation of myocardial viability in the infarct zone and 92% (140 of 152 patients) for detection of myocardial ischemia. In case of disagreement, a consensus was reached.

On the basis of the response to DSE three groups of patients were identified: group 1 included 95 patients (62.5%) showing an ischemic response to DSE, group 2 was composed of 32 patients (21%) showing myocardial viability in the infarct zone without ischemia either in the infarct zone or at a distance and group 3 included 25 patients (16.5%) with no evidence of myocardial viability or ischemia. In group 1 mean baseline WMSI decreased from 1.52 ± 0.34 to 1.28 ± 0.25 ($p < 0.0001$) at low doses and then increased to 1.75 ± 0.29 ($p < 0.0001$ versus baseline and low doses) at peak stress. In group 2 WMSI decreased from 1.47 ± 0.32 at baseline to 1.22 ± 0.23 at low doses ($p < 0.0001$) and did not change significantly at peak stress (1.19 ± 0.31); in group 3 it did not change significantly from baseline (1.72 ± 0.42) to low-dose dobutamine (1.72 ± 0.42) and peak stress (1.75 ± 0.45).

Table 1. Clinical and Echocardiographic Findings in the Three Groups of Patients Studied

	Group 1	Group 2	Group 3
Age (yr)	54 ± 8	52 ± 7	58 ± 10*
Sex (M/F)	88/7	30/2	24/1
Hypertension % (n)	25 (24/95)	31 (10/32)	24 (6/25)
Previous angina % (n)	12 (11/95)	9 (3/32)	16 (4/25)
Site of AMI % (n)			
Anterior	56 (53/95)	28 (9/32)*	64 (16/25)
Inferior	43 (41/95)	69 (22/32)	36 (9/25)
Lateral	1 (1/95)	3 (1/32)	0
Non-Q AMI % (n)	32 (30/95)	22 (7/32)	12 (3/25)
Peak CK (IU/L)	2,014 ± 1,544	1,789 ± 1,340	3,024 ± 1,903*
Baseline WMSI	1.52 ± 0.34	1.47 ± 0.32	1.72 ± 0.42*
Beta-blockers % (n)	47 (45/95)	40 (13/32)	36 (9/25)
Nitrates % (n)	38 (36/95)	56 (18/32)	56 (14/25)
Calcium antagonists % (n)	16 (15/95)	6 (2/32)	8 (2/25)

WMSI = wall motion score index; *$p < 0.05$ versus other groups.

Of the 95 patients with an ischemic response to DSE (group 1), 83 (87%) had ischemia in the infarct zone only, 8 (8%) showed ischemia both in the infarct zone and at a distance and 4 (4%) had only remote ischemia. Of the 91 patients with ischemia in the infarct zone 82 (90%) showed a biphasic response to DSE, whereas 9 (10%) showed a direct deterioration of regional wall motion from normokinesia or hypokinesia to akinesia. The test was positive for myocardial ischemia at the dose of 20 μg/kg/min or lower in 10 patients (10.5%), of >20 μg/kg/min in 68 patients (71.5%) and after atropine in 17 patients (18%). During DSE a ≥1 mm ST-segment shift developed in 46% of group 1, 25% of group 2 and 36% of group 3 patients; 17% of group 1, 3% of group 2 and 8% of group 3 patients had chest pain.

Comparison of clinical characteristics. The main clinical characteristics of patients in the three groups are compared in Table 1. Anterior AMI was more frequent in group 1 and group 3 patients (56% and 64%) compared with group 2 patients (31%, $p < 0.05$). Group 3 patients with no myocardial viability were older and had significantly higher peak creatine kinase and baseline WMSI compared with the other two groups.

Cardiac events during follow-up. During a follow-up of 15 ± 19 months there were 10 hard events, which included 4 deaths and 6 nonfatal AMI; 53 patients developed unstable angina and 67 underwent coronary bypass (16 patients) or coronary angioplasty (51 patients). In 46 of 67 patients revascularization was performed because of recurrence of angina. Hard events occurred at a mean of 11 ± 14 months after AMI and unstable angina developed at a mean of 3 ± 5 months. The incidence of hard events, unstable angina, spontaneous events and total cardiac events including revascularization procedures in the three groups of patients is shown in Table 2. Cumulative survival free of hard events of group 1 patients with viability and ischemia was significantly lower ($p < 0.05$) than that of

Table 2. Cardiac Events During Follow-up in the Three Groups of Patients

	Group 1 (n = 95)	Group 2 (n = 32)	Group 3 (n = 25)
Death	4 (4.2%)	0	0
AMI	6 (6.3%)	0	0
Hard events	10 (10.5%)	0	0
Unstable angina	41 (43%)	7 (22%)	5 (20%)
Spontaneous events	51 (54%)	7 (22%)	5 (20%)
Total events	69 (72%)	8 (25%)	7 (28%)

AMI = acute myocardial infarction.

group 2 patients with viability without ischemia, whereas the difference did not attain statistical significance ($p = 0.06$) in comparison with group 3 patients without viability (Fig. 1). Hard events were observed in 3 of 10 patients with a positive response at a dosage of ≤20 μg/kg/min and in 7 of 85 with a positive response at higher doses (30% versus 8%, $p < 0.05$). The incidence of hard events was not different in patients with ischemia in the infarct zone and in those with remote ischemia (10% versus 17%). Sensitivity, specificity, positive and negative value of DSE for prediction of hard events were 100%, 40%, 9% and 100%, respectively.

As shown in Figure 2, cumulative survival rate free of spontaneous events in group 1 with myocardial ischemia during DSE was significantly lower in comparison with group 2 ($p < 0.002$) and group 3 ($p < 0.005$), whereas no significant difference was found between groups 2 and 3. Seven of 10 patients (70%) with an ischemic response at a dose of ≤20 μg/kg/min and 34 of 85 patients (40%) with a positive response at a >20 μg/kg/min dosage had unstable angina. Therefore, spontaneous events were significantly more frequent in patients with a positive response at a ≤20 μg/kg/min dose than in those with positivity at higher doses (100% versus 48%, $p < 0.01$). Unstable angina developed more frequently in patients with remote ischemia than in those with a positive response in the infarct zone, but the difference was not statistically significant (58% versus 41%). When all cardiac events, including myocardial revascularization procedures when they occurred as a first event, were considered, group 1 patients with myocardial ischemia at DSE had an all event-free survival rate significantly lower than that of group 2 ($p < 0.0001$) and group 3 ($p < 0.001$) patients, whereas no significant difference was found between groups 2 and 3. Sensitivity, specificity, positive and negative value of DSE were 81%, 51%, 54% and 79% for prediction of spontaneous events and 82%, 62%, 72% and 74% for prediction of total cardiac events, respectively.

Prognostic analysis. The univariate and multivariate prognostic factors for cardiac events are shown in Table 3. The most important univariate predictor of hard events was positivity of DSE for myocardial ischemia, followed by the WMSI at peak stress, the difference between WMSI at peak stress and WMSI at low-dose DSE and angina during DSE. For spontaneous events, the most significant predictor was positivity of DSE for myocardial ischemia followed by the difference between peak stress and low-dose DSE WMSI and by the peak stress WMSI. At multivariate analysis only the extent of ischemic myocardium, expressed as the difference between peak stress and low-dose DSE WMSI and angina during DSE remained statistically significant independent predictors of hard events. Difference between peak WMSI and low-dose DSE WMSI was 0.53 ± 0.24 in patients with hard events and 0.27 ± 0.27 in those without hard events. For spontaneous events, positivity of DSE for myocardial ischemia was the strongest independent predictor, followed by ST-segment depression during test, angina during DSE and age.

Discussion

Prognostic significance of myocardial ischemia. In post-AMI patients stress-induced myocardial ischemia has been recognized as a strong predictor of future cardiac events in the prethrombolytic era (18–20), but its prognostic value in patients receiving thrombolytic treatment is still controversial

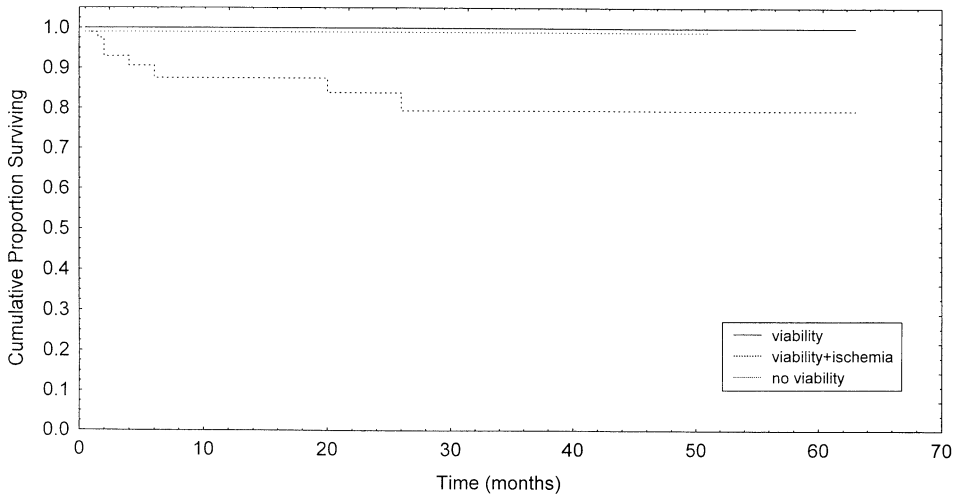

Figure 1. Kaplan-Meier event-free survival curves for hard events in patients with myocardial viability and ischemia (group 1), myocardial viability without ischemia (group 2) and no myocardial viability (group 3) during dobutamine stress echocardiography. Cumulative survival free of hard events was significantly lower ($p < 0.05$) in group 1 compared to group 2 patients, whereas the difference between group 1 and group 3 did not reach statistical significance.

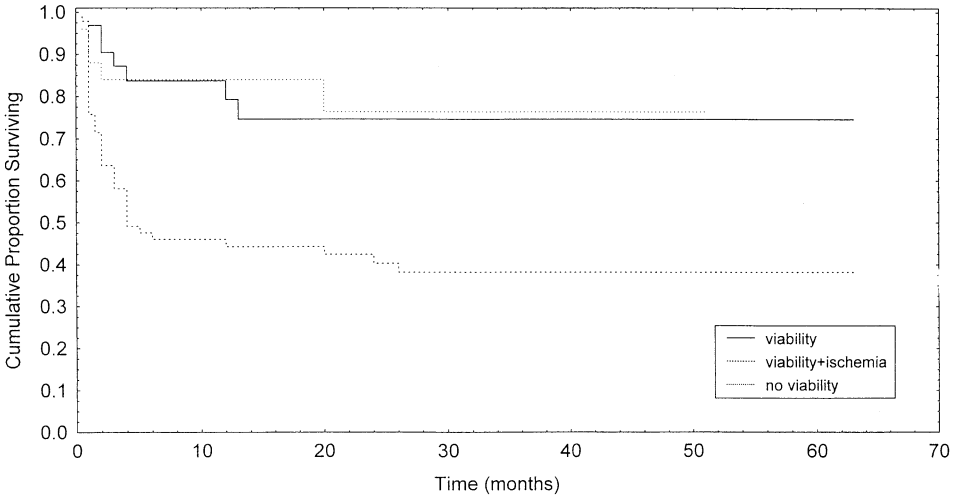

Figure 2. Kaplan-Meier event-free survival curves for spontaneous events in patients with myocardial viability and ischemia (group 1), myocardial viability without ischemia (group 2) and no myocardial viability (group 3) during dobutamine stress echocardiography. Cumulative survival free of spontaneous events was significantly lower in group 1 patients compared to group 2 ($p < 0.002$) and group 3 patients ($p < 0.005$), whereas no difference was present between group 2 and 3.

(6,13,15,21–24). The results of this study show that in patients treated with thrombolysis the presence and extent of myocardial ischemia detected by DSE is the most important predictor of hard events and recurrence of unstable angina, whereas myocardial viability does not show an independent prognostic value. An ischemic response to DSE was associated with a 9% rate of hard events and a significantly higher rate of unstable angina and revascularization procedures during the follow-up, whereas no hard events occurred in patients without myocardial ischemia during DSE, irrespective of the presence or absence of myocardial viability. Our results are in keeping with several studies using exercise (25), dipyridamole (24,26) and dobutamine (11,15) stress echocardiography, which have shown that patients with positive results early after AMI have a significantly higher incidence of reinfarction and unstable angina than patients with negative results; moreover, it has been shown that stress echocardiography can predict the site of AMI up to 1 year after the test (27).

In the present study DSE detected myocardial ischemia more frequently within the infarct zone than at a distance; remote ischemia was documented in only 13% of patients with a positive DSE and did not emerge as a significant predictor of events. Our results are in agreement with those reported by Dakik et al. (28), who showed that in a population treated with

Table 3. Univariate and Multivariate Predictors of Hard Events, Spontaneous Events and Total Events

Univariate Analysis	Chi-square test	p Value	Multivariate analysis	p Value	HR (95% CI)
Hard events			Hard events		
Ischemia at DSE	7.65	0.006	Peak stress-low dose WMSI Δ	0.02	21.7 (1.69–279)
Peak stress WMSI	7.38	0.007	Angina during DSE	0.03	4.45 (1.13–17.5)
Peak stress-low dose WMSI Δ	9.46	0.002			
Angina during DSE	12.8	0.0003			
Spontaneous events			Spontaneous events		
Ischemia at DSE	14.8	0.0001	Ischemia at DSE	0.001	2.92 (1.52–5.59)
Peak stress-low dose WMSI Δ	10	0.002	ST depression during DSE	0.04	1.71 (1.02–2.85)
Peak stress WMSI	9	0.003	Angina during DSE	0.2	1.53 (0.80–2.93)
ST depression during DSE	8.71	0.003	Age	0.05	0.96 (0.93–0.99)
Baseline WMSI	5.29	0.02			
Angina during DSE	4.81	0.03			
Total events			Total events		
Ischemia at DSE	22.6	0.0000	Ischemia at DSE	0.000	3.56 (1.86–6.78)
Peak stress-low dose WMSI Δ	18.95	0.0000	ST depression during DSE	0.06	1.5 (0.98–2.35)
Viability and ischemia during DSE	17.17	0.0002	Myocardial viability at DSE	0.09	0.51 (0.80–19.3)
Peak stress WMSI	13.15	0.0003	Baseline-low dose WMSI Δ	0.09	3.94 (0.23–1.13)
ST depression during DSE	8.06	0.004			
Baseline-low dose WMSI Δ	7.52	0.006			
Baseline WMSI	4.98	0.003			
Age	4.01	0.04			

CI = confidence intervals; DSE = dobutamine stress echocardiography; HR = hazard ratio; WMSI = wall motion score index; Δ = difference.

thrombolysis, 70% of patients with scintigraphic evidence of ischemia had it localized in the infarct zone only and found that the presence of infarct-zone redistribution was a significant predictor of cardiac events. In patients with a first AMI also Sicari and al. (13) and Greco and al. (15) detected myocardial ischemia by DSE more frequently in the infarct zone than at a distance. On the other hand, in the study by Carlos and al. (11) rest or dobutamine-induced asynergy outside the infarct zone was found in a higher proportion of cases compared to the previously reported studies and was an independent predictor of an adverse outcome. This discrepancy is probably related to the high prevalence of multivessel disease (54%) in the population studied by Carlos et al.; moreover, early revascularization of the infarct-related coronary artery was carried out in 29% of their patients and may have prevented the adverse influence of periinfarction ischemia on prognosis. In our study the extent of ischemic myocardium at peak DSE and positivity of DSE at a dose $\leq$20 μg/kg/min were significantly correlated with both hard and spontaneous events. These findings are in keeping with recent studies showing that the severity and extent of stress-induced myocardial ischemia can effectively stratify patients into high- and low-risk groups (24,28,29).

In this study DSE showed a high negative predictive value for both hard and spontaneous cardiac events and therefore, could be useful to identify patients at low risk of subsequent events. On the other hand, in keeping with the low positive predictive value reported by Greco et al. (15) for DSE (11%) and by Picano et al. (24) for dipyridamole (6%), the specificity and positive predictive value of DSE for hard events were only 40% and 9%.

Prognostic significance of myocardial viability. In this study a significant minority of patients (21%) showed myocardial viability in the infarct zone with no detectable ischemia during DSE. The absence of inducible ischemia in an infarcted region showing viability could be explained by the fact that the coronary artery supplying this region has no residual critical stenosis. This hypothesis is supported by angiographic studies in AMI, which showed that early after thrombolysis a percentage of patients ranging from 10% (30) to 47% (31) has a $<$60% stenosis of the infarct-related coronary artery. In our study patients showing myocardial viability without ischemia had an excellent prognosis, with an incidence of hard events and recurrence of angina significantly lower than that of patients with ischemia and similar to that of patients without viability. Thus, these patients should be distinguished from those showing viability and ischemia for both prognostic and therapeutic purposes. The results of our study are at variance with the findings of previous studies showing that myocardial viability detected by positron emission tomography (32,33) or DSE (13,14) had an adverse influence on prognosis. However, these studies evaluated different populations, characterized by chronic coronary artery disease and severe LV dysfunction (14,32,33) or did not assess separately the prognosis of post-AMI patients showing viability with or without ischemia (13). Thus, further studies are needed to better define the prognostic role of myocardial viability in different subsets of patients with variable degrees of LV dysfunction and chronic or acute coronary artery disease.

Study limitations. The study population was composed of selected patients with a first AMI treated with thrombolysis and preserved or mildly impaired LV function. Thus, the study results cannot be applied to the general population of patients with AMI, of whom 15% to 30% had a previous AMI and a significant proportion does not receive thrombolytic therapy. At the time of DSE 44% of patients were treated with beta-adrenergic blocking agents, which could have interfered with detection of both myocardial viability and ischemia. However, this finding reflects a common clinical practice, as withdrawal of beta-blockers would be unpractical or even controindicated early after AMI. Finally, coronary angiography was performed only in a minority of patients and therefore, its prognostic value was not investigated. The prognostic value of coronary angiography after AMI is well established, but the procedure may not be feasible and cost effective in all patients with a first uncomplicated AMI.

Clinical implications. Patients showing myocardial viability and ischemia early after a first AMI treated with thrombolysis are at higher risk of hard events and recurrence of angina, whereas those showing either viability without ischemia or no residual viability in the infarct zone have a good prognosis and could be managed initially with medical treatment. Owing to its high negative predictive value DSE can be useful for an accurate early identification of patients at low risk of subsequent cardiac events; on the other hand, its low positive predictive value for hard events suggests that a further stratification of patients with an ischemic response to DSE based on the extent of ischemia and dose of dobutamine at which ischemia develops is necessary to identify patients at higher risk of events who require early aggressive treatment.

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